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BUILDING PHYSICIANS' TRUST IN E-HEALTH: AN APPLICATION TO EHCR SYSTEMS

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Abstract

This paper explains physicians' acceptance, in terms of usage intentions, of one of the most relevant eHealth services or applications: Electronic Health Care Records (EHCR). For this purpose, the original structure of the Technology Acceptance Model (Davis et al. 1989: 985), which included perceived usefulness, perceived ease of use, attitude, and usage intention, is extended with trust and risk-related factors such as physicians' perceptions of institutional trust, perceived risk, and information integrity. The results stress the special importance of cognitive instrumental processes (mainly, usefulness perceptions) and attitudinal dimensions (attitude towards usage and perceived institutional trust), as key determinants of physicians' acceptance of EHCR systems. Perceptions of institutional trust exert strong direct effects on physicians' perceived usefulness, perceived ease of use, and attitude towards the use of EHCR. Additionally, trust mediates the influence of perceived risk and information integrity perceptions on physicians' acceptance of EHCR.

Keywords: EHCR, TAM, Trust, Physicians

1 INTRODUCTION

Information and Communication Technologies (ICTs), mainly those based on the Internet, are dramatically modifying how companies, employees, and customers interact in service encounters (Bitner, Brown and Meuter 2000; Hoffman and Novak 1996; Parasuraman and Colby 2001). Health care, where interpersonal interactions between health staff and patients determine to a great extent service quality and patient satisfaction, will require challenging modifications (eg, changing the behavioral patterns of patients, physicians, and other health staff), in order to fully benefit from the improvements promised by Internet technologies (Yarbrough and Smith 2007).

Previous studies in the eHealth and telemedicine research fields (Chau and Hu 2002), suggest that integrating technology into processes of health care delivery poses both management and technological challenges. This includes the need to understand the technology acceptance decisions of individual users (Chau and Hu 2002; Yarbrough and Smith 2007). In this sense, physicians' resistance to use eHealth systems has been identified as a key barrier for the effective integration of such digital services or applications.

Physicians' influence has been highlighted in the organizational implementation of health information systems (Lapointe and Rivard 2005; Payton 2000). The special importance of doctors has been attributed to their role of service creators in the health care sector (Payton 2000). However, a review of previous literature evidences that theoretically-grounded research on the adoption Internet-based services among health professionals is rather scarce (Chau and Hu 2002; Sands 1999; Yarbrough and Smith 2007). Available studies have been predominantly descriptive, focusing on the potential benefits of eHealth for physicians and patients (Widmer and Shepherd 1999).

Further research is needed, especially empirical studies into the antecedents and determinants, current behaviors, main purposes, and consequences of patients' and physicians' uses of different eHealth services (Miller, Hillman and Given 2004). Based on relevant theoretical models from the information systems, marketing, social psychology, management, and health care research streams (eg, Bitner et al. 2000; Davis, Bagozzi and Warshaw 1989), this paper analyzes physicians' individual acceptance decisions

of a central component of diverse health information technologies: Electronic Health Care Records (EHCR systems) (Curry 2007).

For this purpose, the relevance of a “core” explanatory model of physicians’ acceptance of EHCR systems is examined, which reflects the core dimensions (perceived usefulness, perceived ease of use, attitude towards the use, and behavioral intention) and causal relationships originally included in the Technology Acceptance Model - TAM (Davis et al. 1989: 985). Additionally, this paper evaluates the “additional” predictive power of trust and risk-related factors, such as physicians’ perceptions of institutional trust, risk, and information integrity, which should be especially relevant in virtual or online contexts of service delivery (Mayer, Davis and Shoorman 1995; McKnight and Chervany 2002; Pavlou 2003; Suh and Han 2003), to explain the physicians’ individual acceptance decisions of eHealth services.

2 THEORY AND HYPOTHESES

The proposed model (see Figure 1) examines the relevance of trust and risk-related dimensions (Mayer et al. 1995; McKnight, Choudhury and Kacmar 2002), as explanatory factors of physicians’ acceptance and use of EHCR systems. For this purpose, the original version of TAM (Davis et al. 1989: 985) is extended by incorporating “trust and risk cognitive processes”, such as institutional trust, perceived risk, and information integrity (Mayer et al. 1995; McKnight et al. 2002). Next, relevant constructs are described, and theoretical arguments are developed for the causal relationships of the model.

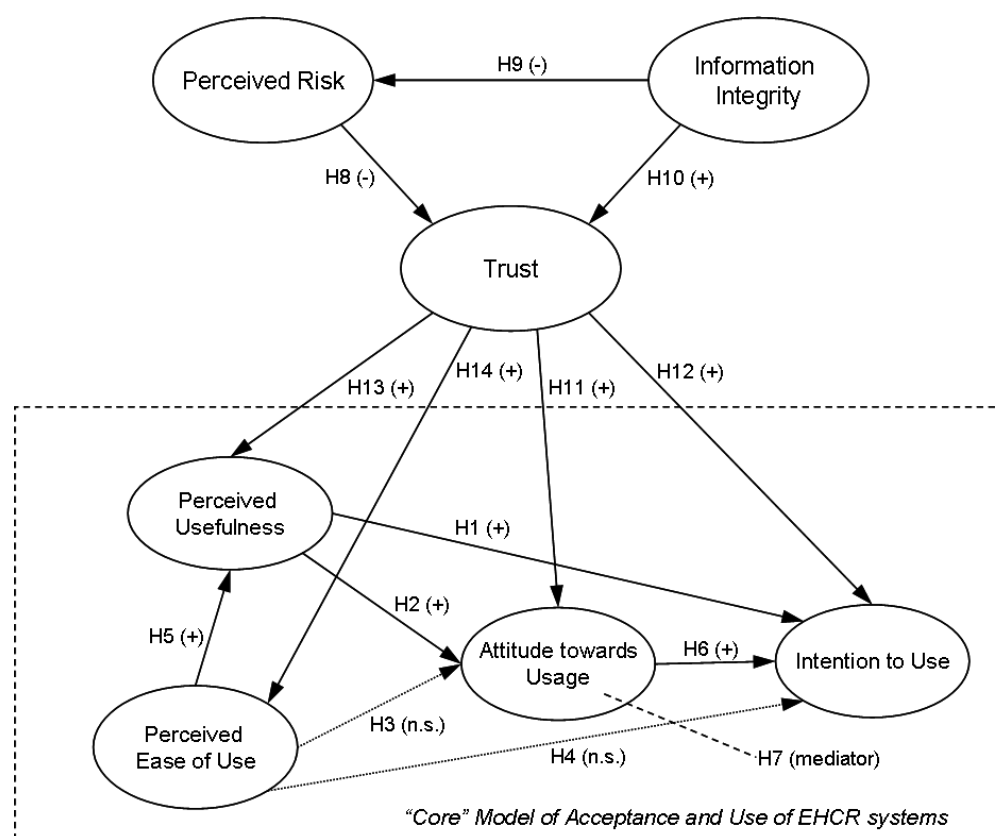


Figure 27. “Extended” TAM model with trust and risk dimensions.

2.1 TAM constructs and relationships

Based on the nomological structure of the Theory of Reasoned Action – TRA (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), TAM establishes that two fundamental beliefs, perceived usefulness and perceived ease of use, determine an individual’s attitude towards the use, behavioral intention, and

actual usage of information systems (Davis et al. 1989). Since the introduction of this model, TAM has provided clear evidences of its robustness, parsimony, and predictive power in studies over a wide range of information and technological systems (Davis et al. 1989; Davis and Venkatesh 1996; Venkatesh and Davis 2000).

Previous literature reveals the widespread use of the TAM model to understand the individual acceptance decisions of Internet-based applications and services, such as email, Web sites, or online shopping (eg, Gefen 2000; Pavlou 2003; Suh and Han 2003). More recently, TAM (Davis et al. 1989) and extensions of this model (eg, Venkatesh, Morris, Davis and Davis 2003) are increasingly being applied to explain the adoption and acceptance processes of health services based on ICTs (Yarbrough and Smith 2007). Examples of such studies include the analysis of telemedicine (Chau and Hu 2002) and eHealth services (Chismar and Wiley-Patton 2002; Wilson and Lankton 2004).

Using TAM constructs and causal relationships (Davis et al. 1989) to explain the acceptance of eHealth services, such as EHCR systems, will contribute to understand the relative importance of two cognitive instrumental processes (*perceived usefulness* and *perceived ease of use*) and one attitudinal or affective dimension (*attitude towards the use*) as predictors of physicians' *intention to use* information technology for professional purposes (Bitner et al. 2000; Davis et al. 1989). These constructs are reflected in the proposed "core" model of acceptance and use of EHCR systems.

Intention to Use. The most relevant explanatory theories and models of individual technology acceptance decisions, like TAM (Davis et al. 1989), TAM2 (Venkatesh and Davis 2000) or UTAUT (Venkatesh et al. 2003), justify the suitability of people's behavioral usage intention as a proxy of their acceptance of a specific technological system or service (Chau and Hu 2002). Characterized as the "conative component of attitude" (Fishbein and Ajzen 1975: p. 289), behavioral intention (eg, technology usage intentions) is regarded as a direct antecedent of actual behavior (Ajzen and Fishbein 1980; Davis et al. 1989; Fishbein and Ajzen 1975), and a mediator of other potential determinants of behavior (Taylor and Todd 1995; Venkatesh and Davis 2000; Venkatesh et al. 2003).

Selecting usage intention as a dependent variable, instead of actual usage, is especially adequate in research focused on the acceptance of technological systems at an introductory stage of diffusion (Chau and Hu 2002; Rogers 2003; Sheppard, Hartwick and Warshaw 1988). The technological context (acceptance of EHCR systems), collective of analyzed professionals (physicians), and geographic scope (Southern Spanish region) of the present research show clear signs of an early diffusion stage (Rogers 2003; Wilson and Lankton 2004; Yarbrough and Smith 2007).

Perceived Usefulness. In the original development of TAM (Davis et al. 1989: 985) and diverse replications and extensions of this model (eg, Venkatesh and Davis 2000; Venkatesh et al. 2003), perceived usefulness has consistently been identified as the most relevant determinant of technology usage intentions. Defined as "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis et al. 1989), perceived usefulness has also been suggested as a key determinant of physicians' acceptance of technological systems for professional purposes (Chau and Hu 2002; Chismar and Wiley-Patton 2002; Wilson and Lankton 2004; Yarbrough and Smith 2007).

Perceived Ease of Use. Defined as "the degree to which the prospective user expects the target system to be free of effort", perceived ease of use is included in TAM as a second determinant of attitude and intention to use information technologies (Davis et al. 1989). Despite its importance in TAM (Davis et al. 1989) and TAM2 (Venkatesh and Davis 2000), there is conflicting and inconsistent empirical evidence across contexts, with regard to the relevance of perceived ease of use as a direct determinant of attitude and behavioral intention to use technology (Adams, Nelson and Todd 1992; Lee, Teich, Spurr and Bates 2006). On the contrary, previous research has provided higher support for the instrumental benefits or influences of perceived ease of use, through usefulness perceptions, in technology acceptance and usage decisions (eg, Gefen and Straub 2000). Results obtained in the health sector (see Yarbrough and Smith 2007) point to the lower relevance of perceived ease of use to explain physicians'

technology acceptance decisions. The inclusion of perceived ease of use in this research will enable the analysis of its potential instrumental (Davis et al. 1989) and affective mechanisms of influence (Davis et al. 1989).

Attitude towards Usage. Previous literature attributes attitude towards usage a fundamental role as a direct determinant of an individual's intention to use specific technological systems (eg, Chau and Hu 2002; Taylor and Todd 1995). Consistent with TRA (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975) and the Theory of Planned Behavior - TPB (Ajzen 1991), attitude towards usage of a technological system will reflect the user's affective evaluation of the costs and benefits derived from using a new technology (Davis et al. 1989). The first version of TAM (Davis et al. 1989: 985) proposed attitude towards usage as a key direct determinant of intention, and important mediator of other relevant beliefs (usefulness and ease of use).

However, previous empirical research has not always supported the relevance of attitude to explain technology acceptance decisions (eg, Davis et al. 1989). As a result, several authors recommend the exclusion of attitude to increase the parsimony of TAM models (Davis et al. 1989; Venkatesh and Davis 2000; Venkatesh et al. 2003). Conversely, other research identifies attitude towards usage as a fundamental determinant of an individual's intention to use a specific technological system (eg, Taylor and Todd 1995), including studies focused on Internet-based technologies (Suh and Han 2003) and health professionals' intention to use technological services (Chau and Hu 2002). Despite mixed evidence, excluding the attitude dimensions does not seem appropriate in the current study (Chau and Hu 2002).

Hypotheses. According to the nomological structure of TAM (Davis et al. 1989), expectancy-value models such as TRA (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975) and TPB (Ajzen 1991), and the empirical evidence obtained in studies on the acceptance of Internet-based technologies (eg, Pavlou 2003; Suh and Han 2003) and health information systems (Chau and Hu 2002; Wilson and Lankton 2004; Yarbrough and Smith 2007), the following hypotheses are proposed and tested in the "core" model of physicians' acceptance and use of EHCR systems:

Hypothesis 1: Perceived usefulness will have a positive direct effect on intention to use EHCR systems.

Hypothesis 2: Perceived usefulness will have a positive direct effect on attitude towards using EHCR systems.

Hypothesis 3: Perceived ease of use will have no significant direct effect on attitude towards using EHCR systems.

Hypothesis 4: Perceived ease of use will have no significant direct effect on intention to use EHCR systems.

Hypothesis 5: Perceived ease of use will have a positive direct effect on perceived usefulness of using EHCR systems.

Hypothesis 6: Attitude towards usage will have a positive direct effect on intention to use EHCR systems.

Hypothesis 7: Attitude towards usage will completely mediate the effect of other relevant beliefs (excluding perceived usefulness) on intention to use EHCR systems.

2.2 Trust and Risk-related constructs and relationships

Certain aspects of the Internet and other digital networks (eg, dedicated health networks), such as the potential global accessibility of information, intangibility of services, and spatial (and even temporal) separation between the parties involved in online communications or transactions (McKnight and Chervany 2002; Pavlou 2003; Suh and Han 2003), may contribute to higher levels of uncertainty (Bitner et al. 2000; Pavlou 2003; Suh and Han 2003). Owing to the higher uncertainty and risk perceived by potential users of online or digital services, different authors have suggested the need to incorporate trust and risk-related perceptions to explain the acceptance and usage decisions of online services

(Featherman and Pavlou 2003; Gefen 2000; Gefen, Karahanna and Straub 2003; McKnight and Chervany 2002; Pavlou 2003; Suh and Han 2003).

The existence of very limited evidence on the relevance of trust and risk factors, related to the acceptance of technological systems by health professionals, requires the identification of factors which are potentially relevant in other virtual or online contexts of product or service delivery (mainly, in eCommerce contexts) (eg, Hoffman and Novak 1996; McKnight and Chervany 2002; Pavlou 2003; Suh and Han 2003). In this sense, the review of previous literature suggests the consideration of the following trust and risk-related constructs in a conceptual model of physicians' acceptance of eHealth services: perceived institutional trust (Gefen 2000; Mayer et al. 1995; McKnight and Chervany 2002; McKnight et al. 2002), perceived risk (Bauer 1960; Koller 1988; Mayer et al. 1995; Pavlou 2003), and perceived information integrity (Gefen 2000; Suh and Han 2003).

Therefore, the "core" predictive model of acceptance and use of EHCR systems is extended by including physicians' perceptions of *institutional trust*, *risk*, and *information integrity* (Mayer et al. 1995; McKnight and Chervany 2002; Pavlou 2003; Suh and Han 2003). The inclusion of these factors in the "extended" model will clarify their additional predictive power and relative importance to explain physicians' intention to use EHCR systems (Yarbrough and Smith 2007).

Institutional Trust. Across different fields of study, such as social psychology, sociology, economy, information systems and marketing (Doney and Cannon 1997; Mayer et al. 1995; McKnight and Chervany 2002), there is wide consensus on the importance of trust as a driver of human behavior (Hosmer 1995; Mayer et al. 1995; McKnight and Chervany 2002). The existence of trust is fundamental for the success of interpersonal relations and transactions, owing to its role in facilitating social interaction (Mayer et al. 1995; McKnight and Chervany 1996).

In eCommerce settings, trust has been widely conceptualized as a *trusting belief* (Gefen 2000; Mayer et al. 1995; McKnight and Chervany 2002; McKnight et al. 2002), related to a "belief that allows consumers to willingly become vulnerable to Web retailers after having taken the retailers' characteristics into consideration" (Pavlou 2003). However, the relevance of trust is not limited to interpersonal relations, being also applicable to "person-to-person", "organization-to-organization", "person-to-organization", and "person-to-system/environment" interactions (Lee and Turban 2001; McKnight and Chervany 2002; McKnight et al. 2002; Salo and Karjaluoto 2007).

In the eHealth context, an interpersonal approach to trust may be especially relevant to explain certain technology acceptance behaviors, such as patients' or general citizens' drug purchases or health information searches on the Internet (Ferguson 2000; Kassirer 2001; McKnight and Chervany 2002; Meyers 2003; Wilson and Lankton 2004). In these cases, patients' health may be threatened due to a potential lack of integrity or opportunistic behavior on the side of certain providers of health products and services (Peterson and Merino 2003).

In turn, the uncertainty involved in the adoption of eHealth services by health professionals will be more related with a lack of perceived security about the adequate functioning (eg, privacy and security of patient identifiable data) and benefits (eg, efficiency improvements and reduction of medical errors) provided by different technological applications (Dixon 2007). According to these sources of uncertainty for health professionals, the measures of physicians' trust in EHCR systems used in this study correspond to an *institutional trust* approach (McKnight and Chervany 2002).

Perceived Risk. Previous literature acknowledges the importance of risk as a basic component of trust models (Doney and Cannon 1997; Mayer et al. 1995). In this sense, risk and uncertainty are necessary conditions for the relevance of trust as a driver of human behavior, that is, trust is only needed in risky situations (Koller 1988; Mayer et al. 1995). In the field of consumer behavior (Bauer 1960; Mitchell 1999), risk has been frequently related to the perceived possibility to experience negative consequences or losses under uncertain situations (Featherman and Pavlou 2003; Peter and Ryan 1976). Alternatively, other authors propose a view of *perceived risk* based on the subjective expectancy of loss in a given situation (Peter and Ryan 1976).

The literature on perceived risk reveals different facets or types of consequences of risk, which help to characterize perceived risk as a multidimensional construct (Featherman and Pavlou 2003; Mitchell 1999). Featherman and Pavlou (2003) adapted the existing classifications of risk to a context of online service delivery, and highlighted the following risk facets: performance, financial, time, psychological, social, privacy, and overall risk. In the present research, focused on physicians' adoption decisions of eHealth services such as EHCR systems, risk is widely based on the inherent and perceived uncertainty related to the use of ICTs (especially the Internet and other digital health networks) for medical transactions and communications (Yarbrough and Smith 2007). Thus, this study measures perceived risk through the facets of physicians' perceived *performance, time, privacy, and psychological risk*.

Information Integrity. Potential security and privacy problems are regarded as fundamental obstacles for the acceptance of different Internet services (Lee and Turban 2001; Suh and Han 2003). The intangibility and impersonality of online services (Bitner et al. 2000; Featherman and Pavlou 2003), and the potential global access to information through the Internet and other digital networks, may reduce control over information, and contribute to unauthorized accesses and fraudulent uses (Featherman and Pavlou 2003). Suh and Han (2003) identified the following types of potential security breaches in the context of online banking services: (1) information theft, (2) theft of service, (2) corruption of data or information integrity problems, (4) possibility of fraud, and (5) privacy problems.

Therefore, Internet-based services should adhere to strict security standards (Gefen 2000), which ensure the confidentiality, reliability, protection, and integrity of information in different contexts. Suh and Han (2003) adopted a multidimensional approach to security control on the Internet, identifying following categories of security-control requirements: authentication, non-repudiation, confidentiality, privacy protection, and *information integrity*. Among these facets of security control, the importance of confidentiality and privacy protection, as well as perceptions of information integrity, should be emphasized in the context of eHealth usage. Confidentiality and privacy control facets were incorporated in the measures of privacy risk, a facet of the perceived risk construct (Featherman and Pavlou 2003).

Additionally, potential problems of data corruption or lack of information integrity in eHealth use for diagnoses and treatments may pose serious threats to patients' health (Kassirer 2001). Thus, the need to ensure that digitally stored or transmitted data "are not created, intercepted, modified, or deleted illicitly" (Suh and Han 2003) suggests the inclusion of a specific construct of perceived *information integrity* in the "extended" model of physicians' acceptance and use of EHCR systems.

Hypotheses. The strong interrelation between trust and perceived risk (Mayer et al. 1995; McKnight and Chervany 2002) has made difficult to clarify the causal links between both concepts in terms of the directionality of effects, antecedents, and consequences of trust and risk (Lee and Turban 2001; Gefen et al. 2003; Mayer et al. 1995; McKnight et al. 2002). The consideration of risk as the main prerequisite or condition for the relevance of trust as a predictor of human behavior (Mayer et al. 1995), has led several authors to propose perceived risk as a direct antecedent of trust (Koller 1988; Mitchell 1999). Other authors view trust as a relevant antecedent of an individual's perceived risk (Pavlou 2003). A third approach conceives risk perceptions as a moderator of the causal effect of trust on behavioral intention (Mayer et al. 1995).

In the present study, perceived risk is modelled as a negative direct antecedent of trust, owing to (1) the necessary existence of a certain degree of uncertainty for the relevance of trust (Koller 1988; Mitchell 1999), and (2) the early stage of diffusion of eHealth services among health professionals. The negative "perceived risk-trust" structural relationship should reflect the need for a certain degree of uncertainty or risk for trust to be operative in physicians' acceptance decisions of EHCR systems (Mayer et al. 1995; Pavlou 2003). The relevance of the inverse relationship ("trust-perceived risk") is also acknowledged. In the mid- and long-term, a progressive development of trust in eHealth usage should lower the levels of perceived risk and uncertainty (Mayer et al. 1995; Mitchell 1999).

Hypothesis 8: Perceived risk will have a negative direct effect on institutional trust of using EHCR systems.

Additionally, perceptions of information integrity are regarded as a construct closely related to the individual's risk and trust perceptions (Featherman and Pavlou 2003; Lee and Turban 2001; McKnight and Chervany 2002; Suh and Han 2003). In this sense, previous empirical evidence suggest that higher perceptions of information integrity should lower the perceived level of risk, and increase the level of trust in using the technological system or service (Suh and Han 2003). Thus, physicians' perceptions of information integrity associated with the use of eHealth services, such as EHCR systems, should exert a negative influence on perceived risk, contributing at the same time to higher institutional trust in the benefits provided by these technological systems for patient diagnoses and treatment (Kassirer 2001; Suh and Han 2003).

Hypothesis 9: Information integrity will have a negative direct effect on perceived risk of using EHCR systems.

Hypothesis 10: Information integrity will have a positive direct effect on institutional trust of using EHCR systems.

Finally, trust is included in the "extended" model as a direct determinant of physicians' attitude towards using and intention to use EHCR systems (McKnigh and Chervany 2002; McKnight et al. 2002; Suh and Han 2003), as well as perceived usefulness and perceived ease of use (Gefen et al. 2003; Pavlou 2003). In this sense, trust (institutional trust) is proposed as a key mediator (Gefen 2000; Mayer et al. 1995; McKnight and Chervany 2002) of the (indirect) effects exerted by perceived risk and information integrity perceptions on the constructs of the "core" model (ie, perceived usefulness, perceived ease of use, attitude, and usage intention) (Davis et al. 1989).

Hypothesis 11: Institutional trust will have a positive direct effect on attitude towards using EHCR systems.

Hypothesis 12: Institutional trust will have a positive direct effect on intention to use EHCR systems.

Hypothesis 13: Institutional trust will have a positive direct effect on perceived usefulness of using EHCR systems.

Hypothesis 14: Institutional trust will have a positive direct effect on perceived ease of using EHCR systems.

3 METHODS

3.1 Sample

The sample consists of physicians with private medical practices located in the Southern Spanish region, which were surveyed by postal mail. These physicians were selected from the lists published by three of the largest private health insurance companies in Spain. Records from different lists were compared and duplicates were removed, yielding an initial objective population of 6260 physicians. A sample of 1500 physicians was extracted from the initial list through systematic sampling. After two mailing waves, 254 completed and valid questionnaires had been returned, which represents an effective response rate of 18.04%.

3.2 Statistical methodology

Confirmatory factor analysis (CFA) and structural equation modelling (SEM), using the EQS v6.1 statistical software, are respectively applied to examine the psychometric properties of the scales and test the proposed conceptual model and hypotheses. In addition, several statistical tests and criteria (such as Cronbach's alpha values, composite reliabilities, the average variance extracted (AVE), and chi-

square difference tests) are used to analyze measurement reliability and convergent and discriminant validity.

A thorough testing of assumptions for multivariate techniques and preliminary data analyses were carried out, including “multiple imputation” of missing data, analysis of common method variance using Lindell and Whitney’s (2001) “marker variable” approach, or testing multicollinearity, among other analyses.

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